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16. Abstract (MAXIMUM 200 WORDS) The aids to navigation positioning programs AAPS 3.4, ATONIS/AAPS 4.0, and ECPINS/ATON 1.73 were tested for the accuracy of determining range and bearing when used to position floating aids to navigation. These calculations are the key element in determining when an aid is on station, so these programs must yield consistent and correct results. The USCG R&D Center in Groton, CT, conducted the tests by comparing the program output to independently calculated results developed using algorithms obtained from the National Geodetic Survey. Test points at various places around the world were generated to test all possible combinations of quadrants and hemispheres. Both ATONIS/AAPS 4.0 and AAPS 3.4 were found to be accurate to within 0.5 inches in range and within .01 degrees in bearing to the calculated truth measurements. ECPINS/ATON 1.73 was found to be accurate within five inches in range, and .01 degrees in bearing. The Differential Global Positioning System receivers used to position are accurate to two yards so these small differences in range would not be noticeable. All three positioning programs can effectively be used interchangeably and achieve equivalent results.			
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Executive Summary

In spring 1999, the U. S. Coast Guard aids-to-navigation program (G-OPN) determined that testing and evaluation was required on various aid to navigation software tools used for positioning floating and fixed short range aids. As part of the Coast Guard's migration to standard workstation III (Windows NT environment), and as a result of upgrades in the electronic chart navigation software of the new seagoing and coastal buoy tenders, the program expected to have three different software applications in use over the next several years. Questions arose regarding the accuracy and consistency between these applications in positioning aids. The program asked the USCG R&D Center to test and evaluate the existing system, AAPS 3.4, its successor ATONIS/AAPS 4.0, and the aids-to-navigation enhancement to the buoy tender's electronic chart navigation system, ECPINS/ATON 1.71.

A proposal and test plan were developed to determine the accuracy of range and bearing functions used to position floating aids to navigation. These calculations are the key elements in determining when an aid is on station. The R&D Center conducted the tests by comparing the programs' outputs to independently calculated outputs developed using algorithms obtained from the National Geodetic Survey. Test points at various places around the world were generated to test all possible combinations of quadrants and hemispheres. AAPS 3.4 and ATONIS/AAPS 4.0 were tested at the R&D Center with assistance from G-OPN for operation and set-up of ATONIS/AAPS 4.0. ECPINS/ATON 1.71 was tested at the USCG Command and Control Engineering Center in Portsmouth, Virginia, in September, 1999, with the help of the WLB/WLM Land Based Support Facility. ECPINS/ATON 1.73 was tested by the WLB/WLM Land Based Support Facility in December, 1999, to determine if this new revision corrects the discrepancies found in version 1.71. Both sets of data are included in this report.

In order to judge the impact of any calculation differences found; we developed an error budget for positioning that includes all of the relevant error sources involved in the positioning process. The range and bearing calculations (subject of this test), data precision, positioning system accuracy (DGPS), position translation accuracy, and vessel maneuvering accuracy were included in the error budget. When examined in this systematic fashion, the driving factors are the DGPS accuracy and the vessel's maneuvering accuracy. At the accuracy levels found in the testing, the positioning programs themselves are virtually interchangeable with no effect on the positioning performance. The specific results were as follows: both AAPS 3.4 and ATONIS/AAPS 4.0 applications were found to be accurate to within 0.5 inches in range and within .01 degrees in bearing to the calculated truth measurements. ECPINS/ATON 1.73 was found to be accurate within five inches in range and within .01 degrees in bearing to the calculated truth measurements. The errors in version 1.71 were clearly corrected. All three positioning programs can now effectively be used interchangeably and achieve identical results.